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THE 25TH-ANNIVERSARY OF THE SHATURA GRES IMENI V. I. LENIN

Acad A. V. Vinter

A quarter of a century ago, on 25 September 1925, the central switchboard of the Moscow Electric Power Station received current from the Shatura GRES (State Regional Electric Power Station) imeni V. I. Lenin over the first high-voltage power line in the USSR. The Shatura GRES (of which the author was chief of construction) was the first of the great electrification projects carried out by the Soviet regime.

A special step-down substation of the enclosed type had been built at the Moscow station to take the power coming from the Shatura GRES and transform its voltage for the Moscow distribution system. The Shatura-Moscow high-voltage line extends to the center of Moscow by an overhead line running along the banks of the Moscow River.

The Shatura GRES gave the first conclusive and complete demonstration of the feasibility and economic efficiency of the use of low-cost local fuel, in this case peat, by large electric power stations. The peat-operated power station, built in 1914, some 70 kilometers from Moscow (now known as GRES imeni Klasson), had a relatively low installed capacity (15,000 kw) and its operation was unsatisfactory from the standpoint of burning peat. Incomplete combustion was so great that large quantities of charred peat lumps were dumped out together with the ash and slag. The efficient burning of peat in large furnaces and the development of fuel resources in the Moscow area were not achieved until after the Revolution.

The Shatura GRES was planned and executed as a model of Soviet construction. The following problems were among those that had to be solved during the construction period:

1. Organization and equipping of enough peat-winning plants and machines to provide fuel for the future Shatura GRES with an installed capacity of 50,000 kw and an annual output of 250 million kw-hr, i.e., the winning of at least 500,000 tons of air-dried peat per year.

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2. Complete electrification of peat-winning operations and finding power sources for this purpose.

3. More effective solution of the problem of peat combustion in large boilers.

A historical review of the construction of the first link in Soviet electrification should not be limited to problems of the construction and equipping of the power station itself, but should also include the methods by which the group of problems mentioned above were solved.

In the initial period of construction, naturally, problems of peat winning were given priority. The only reliable method at that time was the machine-molding method, using elevators. This method was adopted with modifications in the power equipment, i.e., the use of locomobiles was eliminated and the peat machines were electrified.

Hydropeat [peat cut by water power] was fully developed only after several years, and, subsequently, the peat resources of the Kobelevskiy bog were developed for the needs of the Shatura GRES by this method. Briquetted peat was not known at that time, and burning of pulverized peat was not yet in use.

The years 1918 and 1919 were spent on the careful preparation of the Shatura peat bogs for exploitation, including the building of scores of living quarters and commercial facilities for the vast army of seasonal laborers, the planning of the so-called central section, with its homes, sawmill, woodworking and mechanical workshops, the laying of railroad track to the peat-excavation points, and the installation of an entire power-distribution system in the bogs. As a source of electric power, the Orekhovo substation was selected. It was supplied by the previously mentioned Klasson station. A 30-kv power line from Orekhovo to Shatura was built in the winter of 1919. During the same year, construction of a temporary electric power station with an installed capacity of 5,000 kw was begun in the region of the future Shatura GRES. The temporary station served mainly to supply power for the Shatura peat bogs, and secondarily, to transmit its surplus electric energy over the newly built power line to Orekhovo for the benefit of the Klasson station distribution system. The temporary station served further as a large experimental base for solving the problem of effective peat combustion.

Around 1921, Professor T. F. Makar'yev, the eminent Leningrad steam engineer, was working on the design of a new furnace for lump peat which was to be known by the name Makar'yev shaft-chain grate. The first results obtained with this furnace in a Leningrad station were so much better than anything done before in the practice of peat combustion that the builders of the Shatura GRES decided to continue with the experiments immediately. By summer 1923, careful balance tests had been made of two boilers equipped with Makar'yev grates. The excellent results of these tests were published later (Elektrichestvo, No 1, 1926). The builders of Shatura decided to use Makar'yev shaft-chain grates in the future station.

The results of these tests solved problems not only for Shatura; they revealed new potentialities in furnace techniques and demonstrated the feasibility of more intensive and effective utilization of furnace spaces and heating surfaces.

In June 1923, a commission, headed by the author, went abroad to distribute orders for the equipment of the future station and met with Professor Muenzinger, one of the most prominent steam engineers in Germany at that time. When he heard of the excellent results obtained by us with the Makar'yev grate, he expressed his disbelief with just one word, "impossible." With that, our conversation came to a close. Following this, the order for the Shatura boilers was awarded to the Vitkovice [Iron] Works in Czechoslovakia. The latter accepted the order only on the condition that Makar'yev furnish sketches, specifications, etc.

50X1-HUM

The data on the new Makar'yev grate, which was published in the Soviet periodicals, evoked lively interest abroad and many foreign engineers came to the temporary Shatura station to familiarize themselves on the spot with the operation of the furnace.

The problem of the order for the first turbines for the Shatura GRES was not resolved without serious technical controversies. Since the construction management wanted to build a peat-powered regional electric power station which would be both original and large, it demanded the installation of the most powerful and technically advanced machines. This involved a certain risk because, in 1923, the maximum output of a steam-turbine unit was 10,000 kw with a turbine speed of 1,500 rpm. Hot debates raged at the time, with some arguing in favor of converting to powerful turbines running at 3,000 rpm and others agreeing to build such machines, but with an output of no more than 10,000 kw.

In technical matters, the decision was that of the members of the two commissions for equipment orders, and thus 18,000-kw units (considered powerful at that time) were ordered for Shatura, and 10,000-kw units for the Shterovka and Gor'kiy regional power stations.

Looking back, this controversy seems ridiculous. The contemporary Soviet turbine-building industry produces units for 100,000 kw and higher, operating at 3,000 rpm and at steam pressures as high as 100 atmospheres.

The electrical equipment of the Shatura GRES was in no way different from the instruments and equipment known at that time. The high-voltage section was arranged in an enclosed compartment near the switchboard of the station and was accessible to the personnel on duty there. This arrangement protected the high-voltage equipment from contamination by peat dust and light ashes.

The actual construction of the Shatura GRES, begun at the end of June 1923, was completed by 25 September 1925, at which time the station was put into permanent operation, transmitting all of its electric power to Moscow.

We were able to complete the project within this relatively short period not only because the construction plan and all equipment specifications had been carefully drawn up at the same time, but also because of some other specific conditions, which we would like to discuss in detail in the following paragraphs.

First, the site selected for the construction played an important part. The station was located in a small, dry area between three lakes, namely, Chernoye, Beloye, and Svyatoye lakes. The station is located on the shore of Black Lake, which is typical of the peat bogs. It is perfectly round and of considerable depth toward the center where it forms a deep crater. The two other lakes are shallow but relatively large and sufficient in area of evaporation surface to cool the circulating water of a power station having an output of even more than 100,000 kw. The three lakes are interconnected by natural channels, which eliminated the need for complicated hydrotechnical constructions and expensive cooling installations. The only water-supply facility that had to be constructed was a very short intake canal from the Chernoye Lake to the machine section of the station, from which the centrifugal pumps of the circulating system took water. From the condensers, the circulating water was drained to the Svyatoye Lake through an open concrete canal.

Secondly, the question of peat supply was resolved simply, conveniently, and inexpensively. Freight cars, coming either from the bogs or from warehouses, delivered directly to the dumping bin in the boilerhouse. For this purpose, two light metal sloping trestles of the open type were constructed, along which moved, during peat deliveries, an endless flexible steel cable. Special automatic clamps fastened each freight car to the cable. The cars moved along the track laid on the trestles, with a certain spacing arranged to permit their unloading. Still fastened to the cable, the cars continued downward to the ground on the second trestle where they were uncoupled to make up another train of empty cars.

Thirdly, the 18,000-kw turbine units were mounted on cast-iron columns without the usual labor-consuming concrete and reinforced-concrete work. We were the first to use this method and it proved to be quite effective.

Machines on such foundations consisting of a dozen hollow cast-iron columns have now been in operation over 25 years for tens of thousands of hours each, without ever giving any cause for complaint because of operational defects. In addition, the condenser compartment was kept light, clean, and very convenient for the installation of all kinds of pipelines and equipment. Unfortunately, this type of foundation, although undoubtedly progressive, has not found a place in our electric power station construction practice. While such an arrangement may not be desirable for machines with outputs of 50,000 kw or more, it should prove highly adequate for those with outputs below 25,000 kw.

Finally, an important contributory factor is cutting down the time required for the construction of the Shatura GRES was the simultaneous delivery of all equipment, an achievement due in no small measure to the timely delivery to the contractors of full and detailed specifications, drawings, and diagrams.

The builders of the Shatura GRES maintained a definite order in carrying out the various component works with a view to simultaneous completion of all the links necessary for operation. Thus, as early as 1924, we began the construction of the 120-km double-circuit 1oo-kv transmission line and the enclosed step-down substation at Moscow. These works were distributed among four independent construction sections and were completed by September 1925.

The unusual cleanliness of the boiler room of the Shatura GRES, and particularly of its ash compartment, was unsurpassed and has rightfully been considered exemplary for many years.

From a standpoint of its operational characteristics, the Shatura GRES was the best in the world at that time. As a peat-powered regional electric power station it was, and continues to be, the best station in the world.

Later, the installed capacity of the Shatura GRES was increased more than threefold.

In its 25 years of operation, the Shatura GRES has made a significant contribution to the economy of our country by supplying many billions of kilowatt-hours to the regional network of Mosenergo (Moscow Regional Electric Power Administration).

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